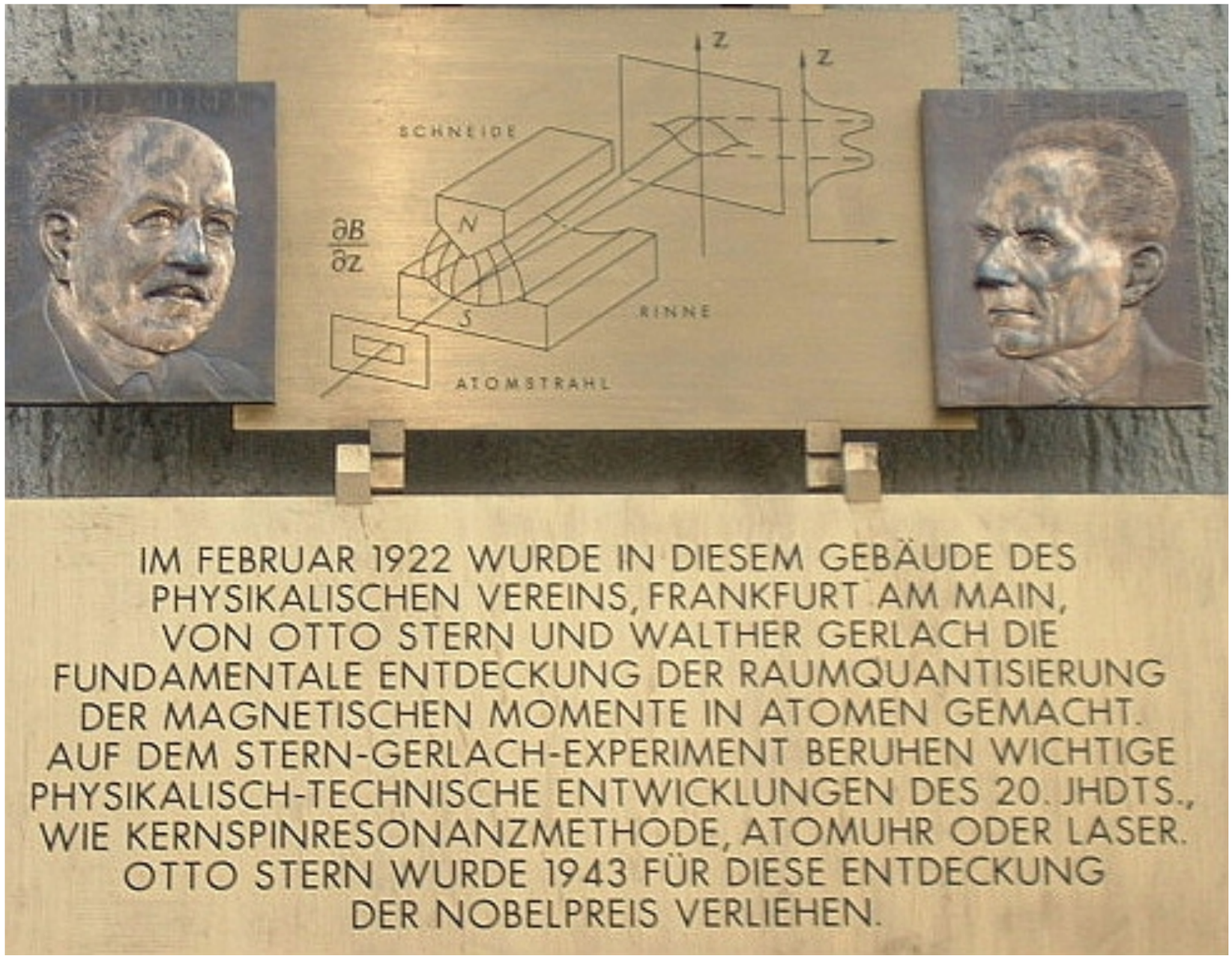
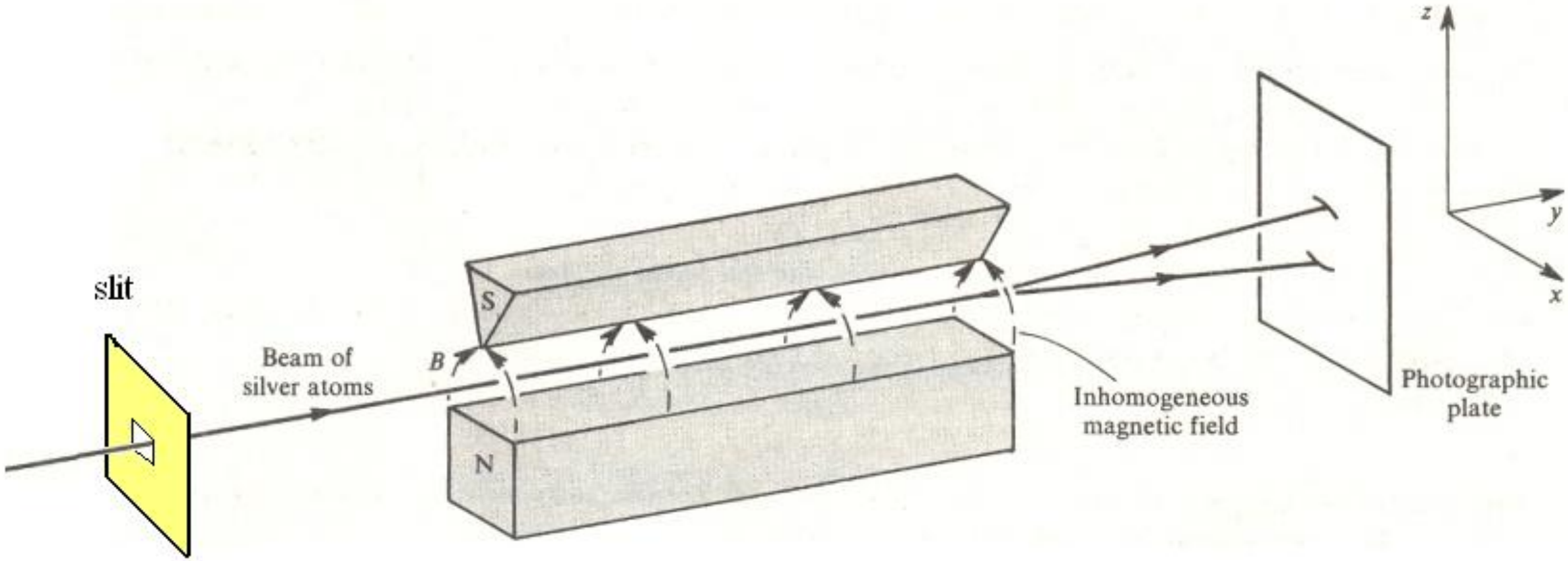
The Stern-Gerlach Experiment

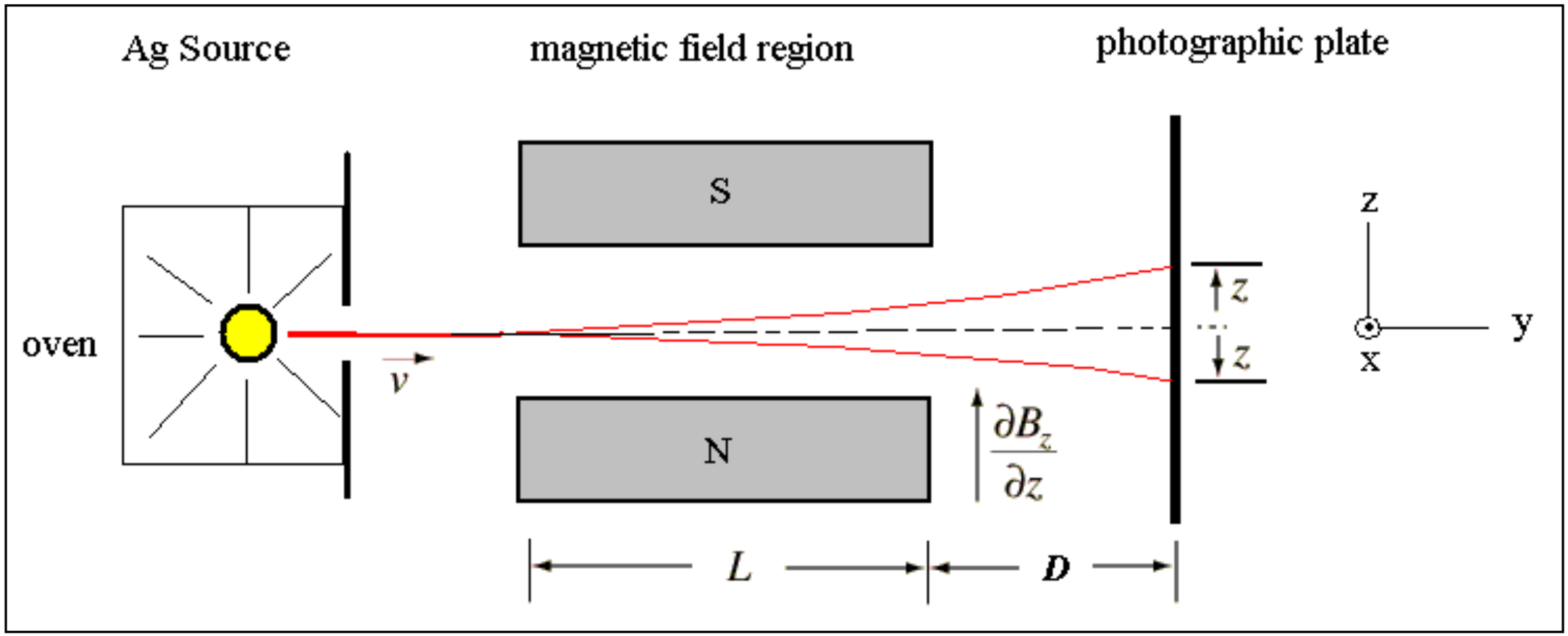
A plaque at the Frankfurt institute commemorating the experiment

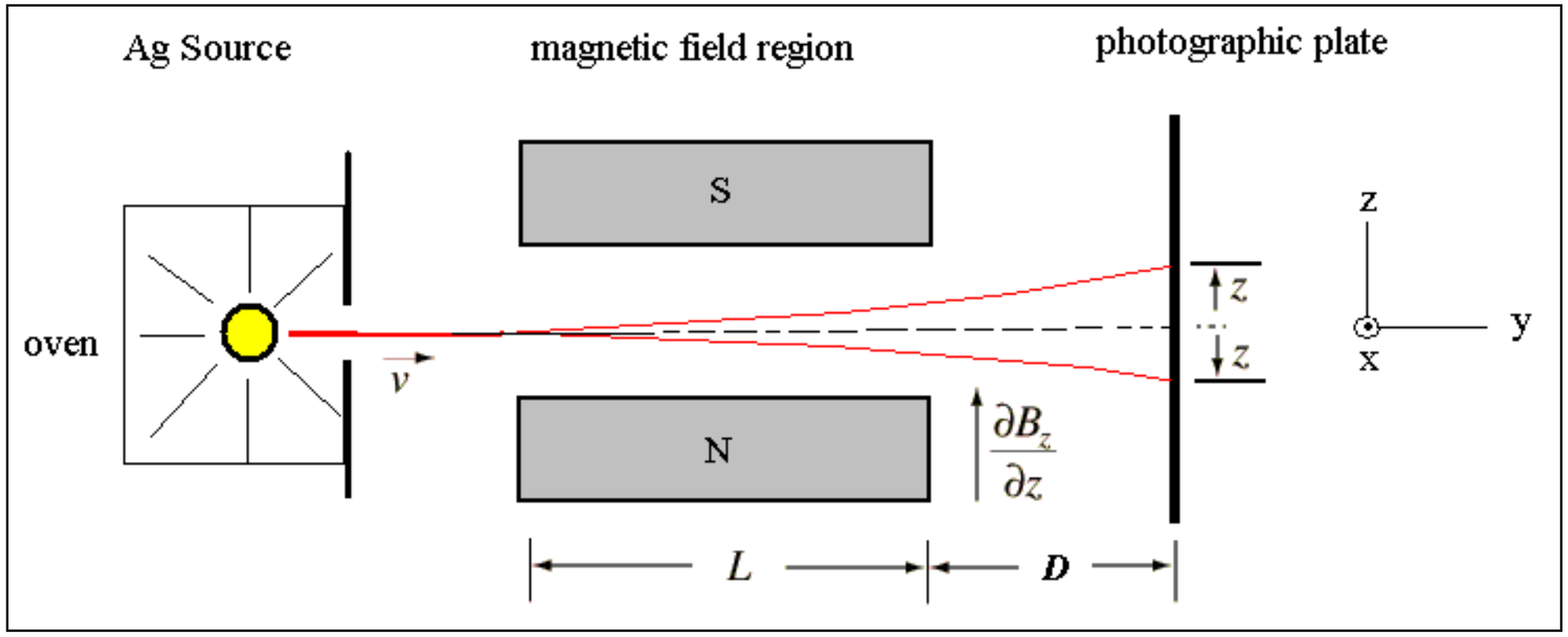


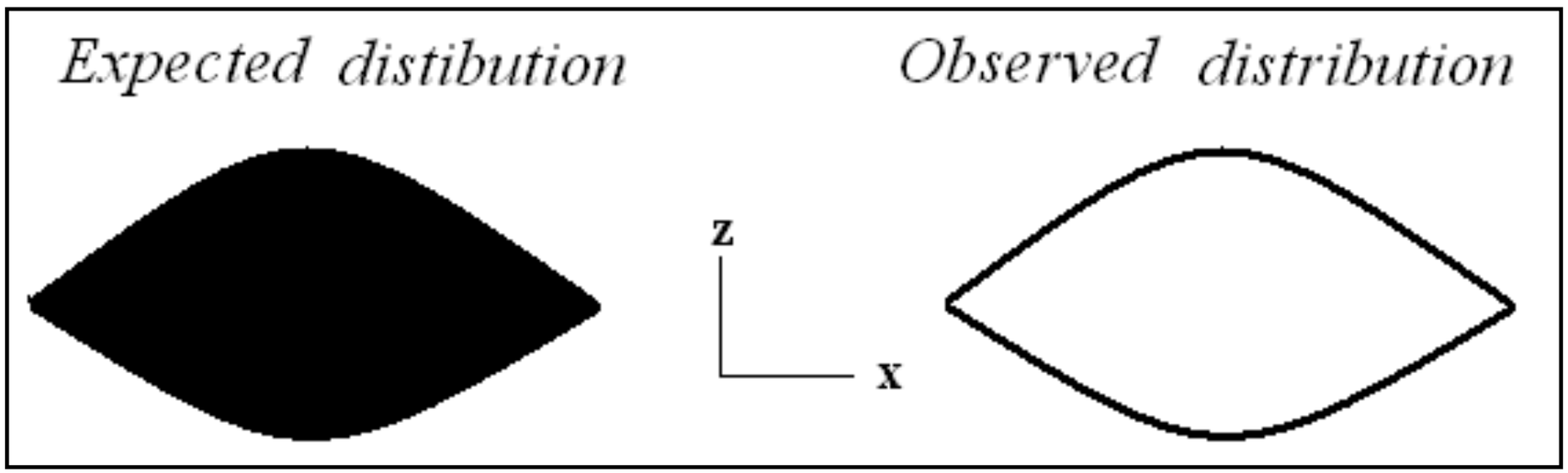
The Stern-Gerlach Experiment



- The Stern-Gerlach Experiment (SGE) is performed in 1921, to see if electron has an intrinsic magnetic moment.
- A beam of hot (neutral) **Silver** ($_{47}$Ag) atoms was used.
- The beam is passed through an *inhomogeneous* magnetic field along z axis. This field would interact with the magnetic dipole moment of the atom, if any, and deflect it.
- Finally, the beam strikes a photographic plate to measure, if any, deflection.


Ag Source
magnetic field region
photographic plate
S
oven
v
N
z
z
z
y
x
$\frac{\partial B_z}{\partial z}$
L
D

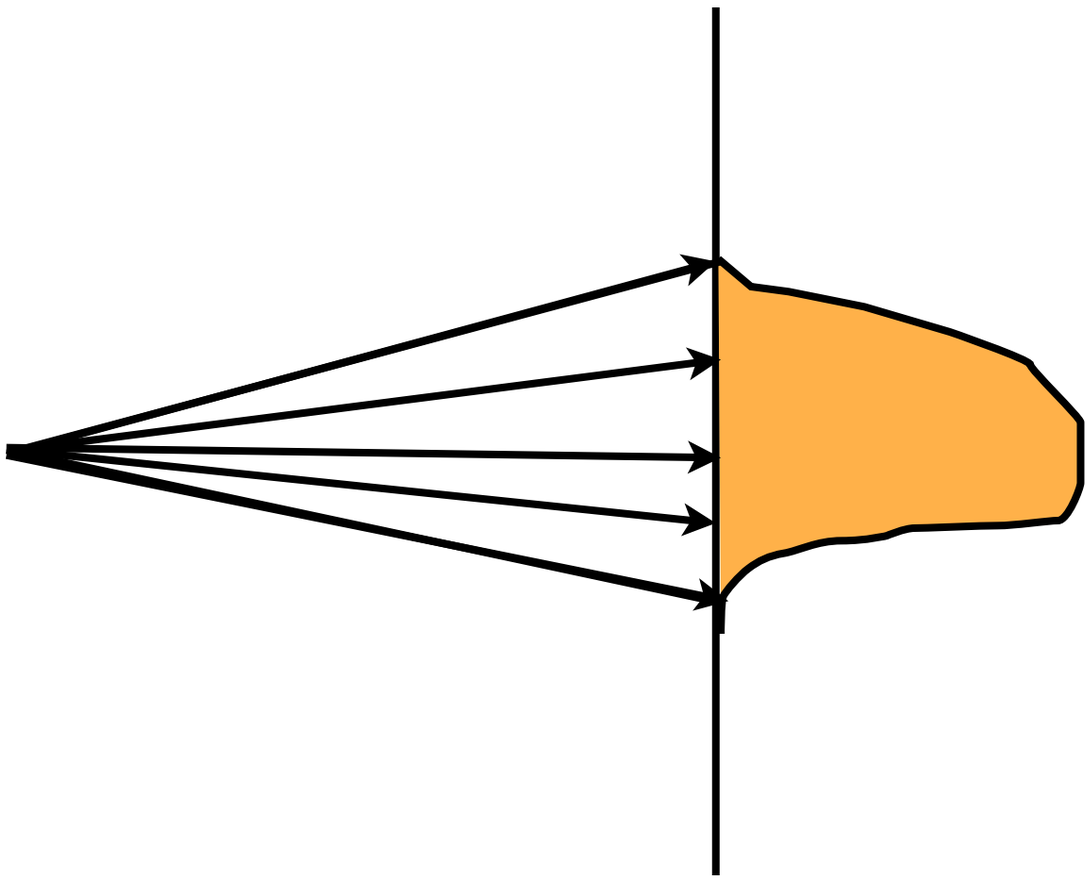




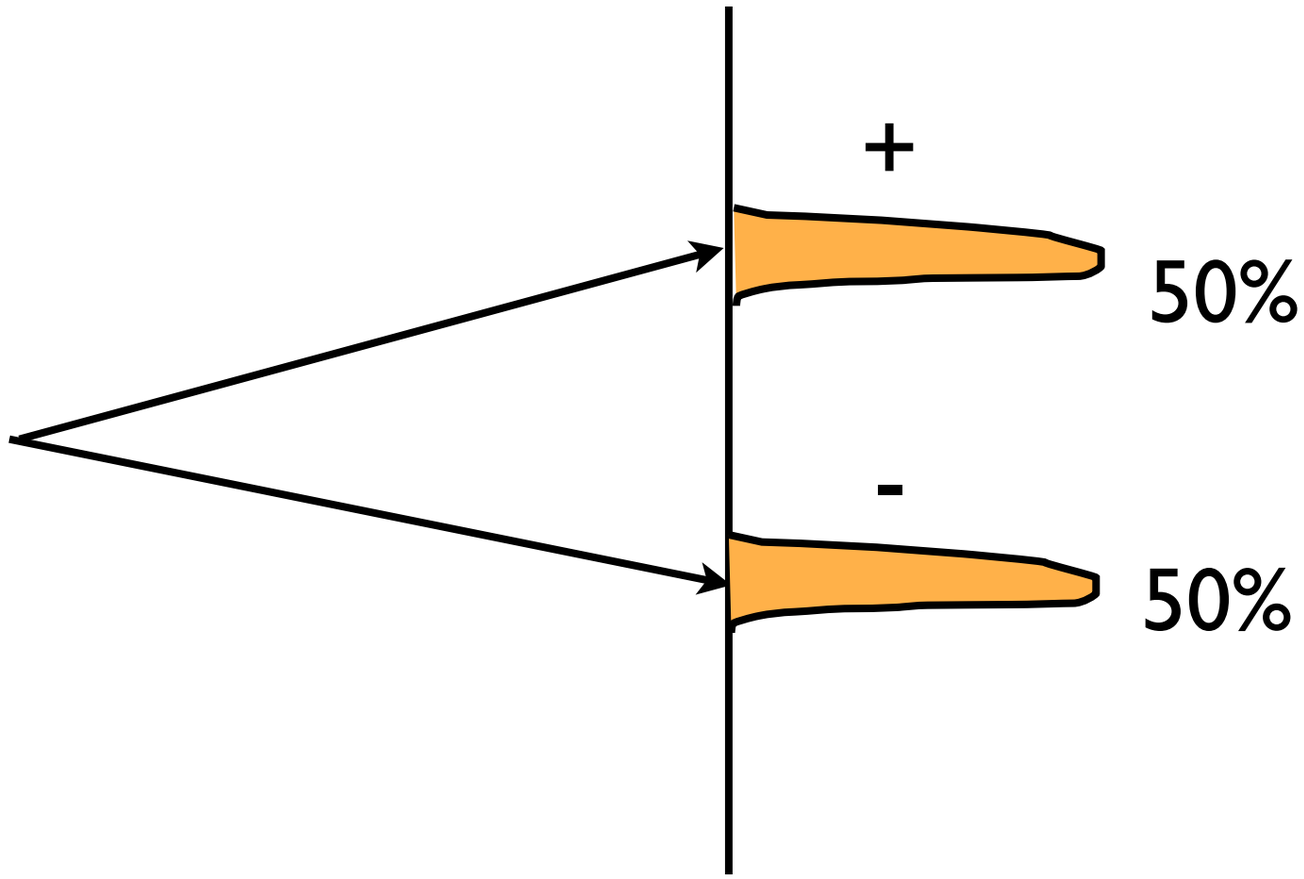
- If the electrons were like ordinary magnets with random orientations, they would show a continues distribution of points. The photographic plate would have shown a continues distribution of impact positions.

- However, in the experiment, it was found that the beam pattern on the photographic plate had split into two distinct parts. Atoms were deflected either up or down by a constant amount, in roughly equal numbers.

- ***Apparently, z component of the electron's spin is quantized.***

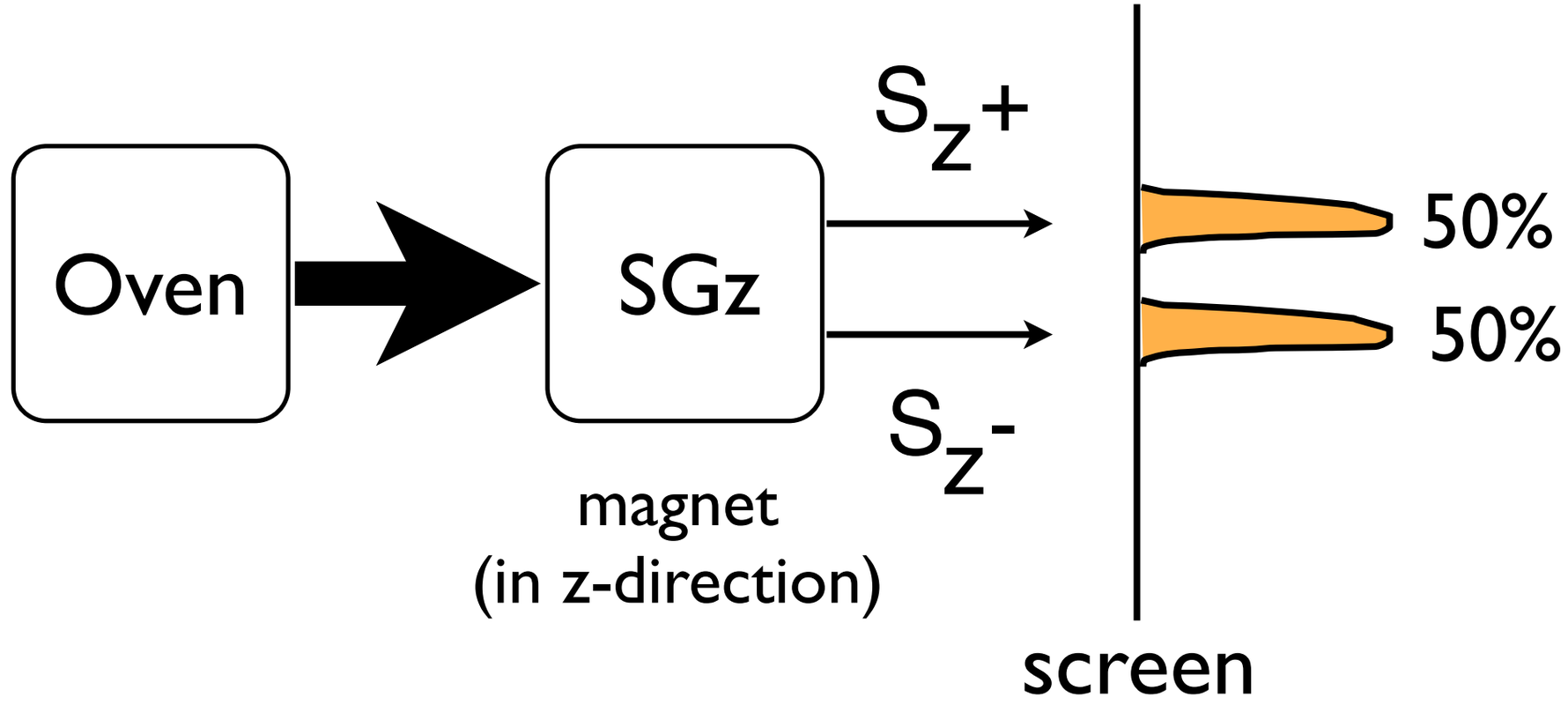


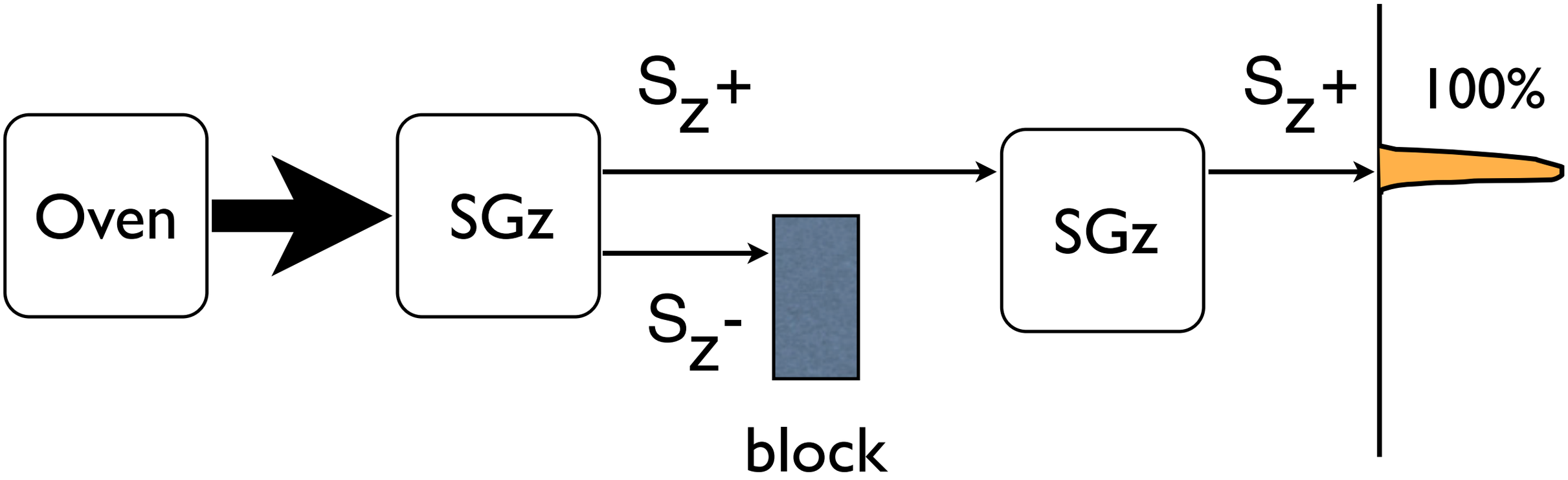
Expected Result
(from Classical Physics)

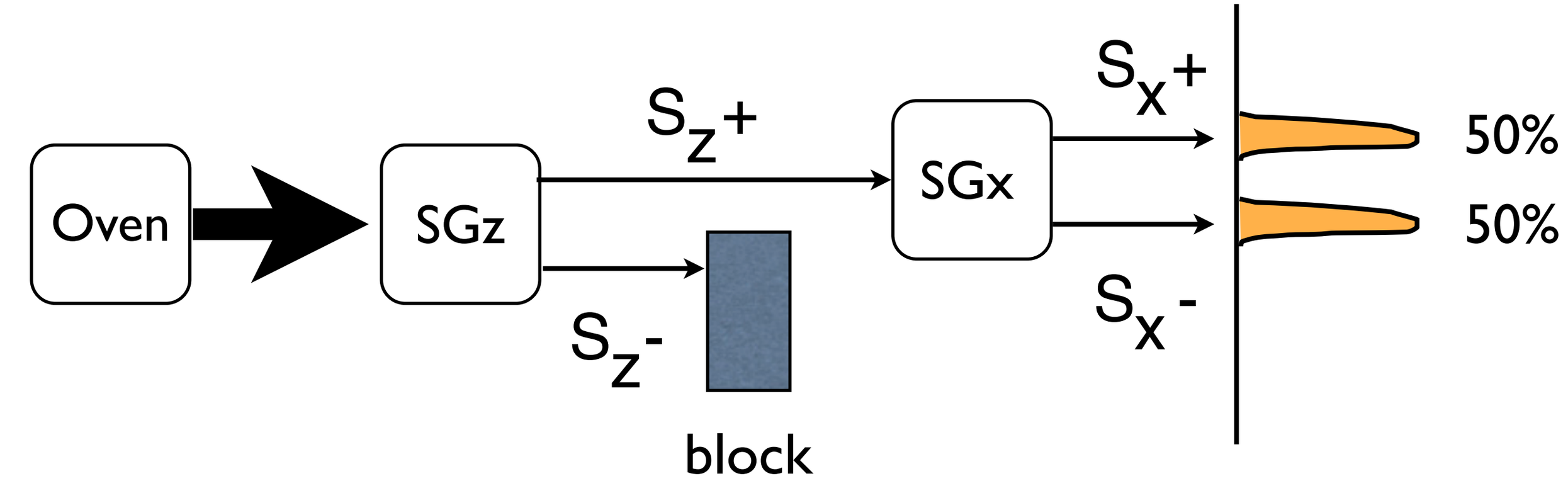


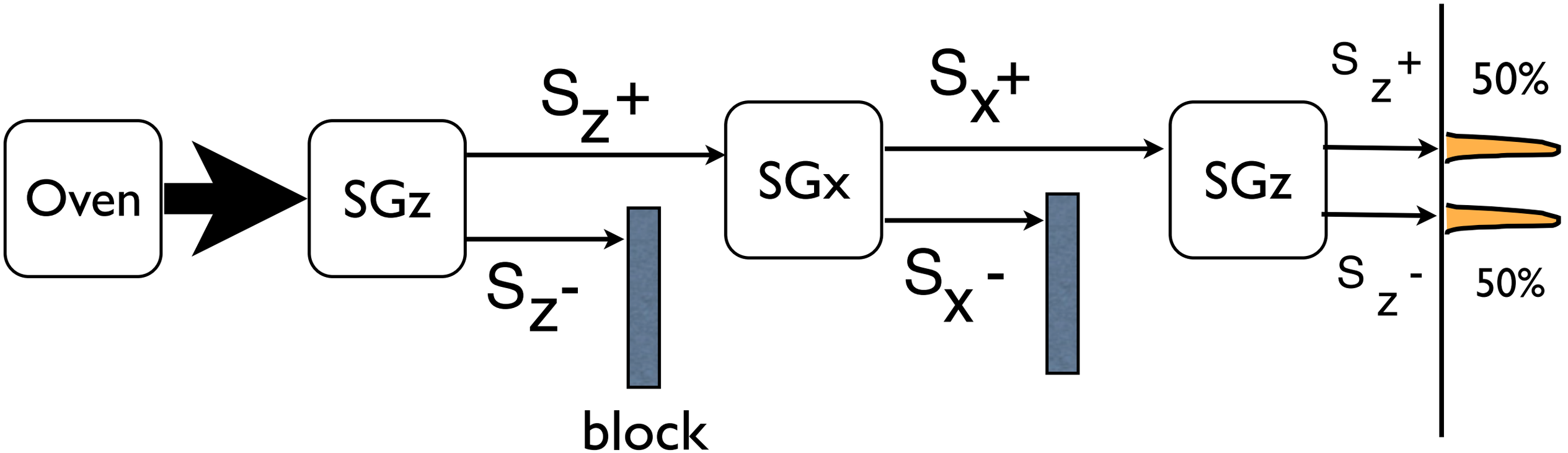
Observed Result
(from Stern-Gerlach Expt.)

Particle's spin is "quantized"


Oven
SGz
S_z+
S_z-
50%
50%
magnet
(in z-direction)
screen


Oven
SGz
S_z+
S_z-
block
SGz
S_z+
100%


Oven
SGz
S_z+
S_z-
block
SGx
S_x+
S_x-
50%
50%


Oven
SGz
S_z+
S_z-
block
SGx
S_x+
S_x-
SGz
S_z+
S_z-
50%
50%